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**ABSTRACT**

Methods for synthesis of nanocrystalline apatites are presented, as well as a series of specific reaction parameters that can be adjusted to tailor, in specific ways, properties in the recovered product. Particulate apatite compositions having average crystal size of less than 150 nm are provided. Products also can have a surface area of at least 40 m<sup>2</sup>/g and can be of high density.

Hydroxyapatite material is investigated in particular detail. Compositions of the invention can be used as prosthetic implants and coatings for prosthetic implants.